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INTRODUCTION.

This REVIEW treats generally the meteorological conditions of the United States and Canada for July, 1889, and is based upon reports of regular and voluntary observers of both countries.

On chart i the paths of the centres of fourteen areas of low pressure are shown; the average number traced for July during the last nineteen years being 9.8. This chart also exhibits the paths of the centres of seven depressions traced over the north Atlantic Ocean; the limits of fog-belts west of the fortieth meridian, and the distribution of icebergs and field ice during the month. The areas of high and low pressure and north Atlantic storms are discussed under their respective headings.

Chart ii exhibits the distribution of mean atmospheric pressure and temperature for the month. The mean temperature generally averaged below the normal east of the Rocky Mountains, while in the Rocky Mountain and plateau regions and on the middle Pacific coast the month was slightly warmer than the average July. At several stations in the southwestern part of the country the absolute maximum temperature was as high, or higher, than has been recorded for July during the periods of observation, while at stations in the Lake region, the upper Mississippi and upper Missouri valleys, and at Portland, Oregon, the minimum temperature was as low, or lower, than previously reported for July.

Chart iii shows the distribution of precipitation for July, 1889. The precipitation was largely in excess of the normal in areas east of the Rocky Mountains. Over the Rocky Moun-

tain and plateau regions and on the Pacific coast it was deficient, except at stations in the southern plateau region, southwestern Oregon, and northern Montana. A remarkable feature of the month was the irregular distribution of rainfall over the eastern half of the country, where large excesses and marked deficiencies occurred in limited areas. The rainfall of the month is discussed under the heading "Precipitation."

Under the headings "Local storms," "Floods," and "Drought" will be found descriptions of the more important storms, disastrous floods, and damaging drought of the month.

In the preparation of this REVIEW data from 2,218 stations have been used, classified as follows: 176 Signal Service stations; 120 monthly registers from United States Army post surgeons; 1,396 monthly registers from state weather service and voluntary observers; 23 Canadian stations; 160 stations through the Central Pacific Railway Company; 343 marine reports through the co-operation of the Hydrographic Office, United States Navy; marine reports through the "New York Herald Weather Service;" monthly weather reports from the local weather services of Alabama, Arkansas, Colorado, Dakota, Illinois, Indiana, Iowa, the Iowa Weather Crop Bulletin Service, Kansas, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Nebraska, Nevada, New England, New Jersey, New York, Ohio, Pennsylvania, South Carolina, Tennessee, and Texas, and international simultaneous observations. Trustworthy newspaper extracts and special reports have also been used.

ATMOSPHERIC PRESSURE (expressed in inches and hundredths).

The distribution of mean atmospheric pressure for July, 1889, as determined from observations taken daily at 8 a. m. and 8 p. m. (75th meridian time), is shown on chart ii by isobars. The difference between the mean pressure for July, obtained from observations taken twice daily at the hours named, and that determined from hourly observations varies at the stations named below as follows: At Washington, D. C., Philadelphia, Pa., New York, N. Y., Boston, Mass., and Saint Louis, Mo., the mean of the 8 a. m. and 8 p. m. observations was higher by .003, .007, .006, .007, and .007, respectively, while at Chicago, Ill., the mean of the observations taken at these hours was .001 lower than the true mean pressure.

The mean pressure for July, 1889, was highest over southeastern Florida, where it rose to 30.10, at Jupiter, and was above 30.05 along the immediate south Atlantic coast and over eastern Florida. From eastern Texas eastward to the Atlantic coast and northeastward to the south New England coast, and along the immediate Pacific coast north of the fortieth parallel, the mean values were above 30.00. The mean pressure was lowest within an area extending from the lower Colorado valley northward over southeastern California and southern Nevada, where the values were below 29.80, and fell to 29.75 at Yuma, Ariz., and Keeler, Cal. On the south Pacific coast, over a greater portion of the middle and southern

plateau regions and the southeastern slope of the Rocky Mountains, in the middle Missouri valley, and from the lower Saint Lawrence valley westward to the one hundred and twelfth meridian the mean pressure was below 29.90.

Compared with the pressure chart for June, 1889, a decrease in pressure is shown, except over the southern half of Florida, in the more southern districts west of the Mississippi River, along the California coast north of the thirty-fifth parallel, and in the upper Missouri valley and the British Possessions to the northward. The greatest increase in pressure occurred in and north of northern Montana, where it was more than .05, and the greatest decrease, .05, or more, in eastern Nova Scotia, and the Atlantic coast states between the thirty-fourth and fortieth parallels. Elsewhere the changes were less than .05. In June the mean pressure was highest, 30.11, on the North Carolina coast, while for the current month the highest value, 30.10, was reported on the southeastern coast of Florida. The changes in pressure within the area of low mean pressure over the southern plateau region have been unimportant.

Compared with the normal pressure for July, the mean pressure was above the normal in the Canadian Maritime Provinces, New England, the lower lake region, along the immediate middle and south Atlantic coasts, over eastern Florida, a portion of the middle and southern plateau regions, and at

stations in north-central Montana and southwestern Wisconsin; elsewhere the mean pressure was below the normal. The greatest departures above the normal were reported in the Canadian Maritime Provinces and the Saint Lawrence Valley, where they exceeded .05, and the most marked departures below the normal were noted at stations on the north Pacific coast and in southern California, where they were more than .05; elsewhere the departures from the normal pressure were small.

BAROMETRIC RANGES.

The monthly barometric ranges at the several Signal Service stations are given in the table of miscellaneous meteorological data. The general rule, to which the monthly barometric ranges over the United States are found to conform, is that they increase with the latitude and decrease slightly, though somewhat irregularly, with increasing longitude. In July, 1889, the ranges were greatest in northeastern New England and the more northern parts of the upper lake region, where they exceeded .70, whence they decreased southward to the Gulf of Mexico, southwestward to the Rio Grande and Gila valleys, and westward to the Pacific. Along the Atlantic coast the extreme ranges varied from .16, at Key West, Fla., to .72 at Eastport, Me.; between the eighty-second and ninety-second meridians, .25 at New Orleans, La., to .74 at Marquette, Mich.; between the Mississippi River and the Rocky Mountains, .27 at Galveston, Tex., to .63 at Fort Sully, Dak.; in the plateau and Rocky Mountain regions, .24 at Whipple Barracks (Prescott), Ariz., to .69 at Walla Walla, Wash.; on the Pacific coast, .26 at San Diego, Cal., to .57 at Olympia, Wash.

AREAS OF HIGH PRESSURE.

Nine such areas affected the weather of the United States during the month of July. They may be divided into three groups, according to geographical distribution. Those of the first group (ii, iii, and viii) developed on the north Pacific coast; the second group (v and vii) first appeared in the Saskatchewan Valley, and the third group (i, iv, vi, and ix) was confined to the Atlantic coast states. Comparing the values of the different groups for the current month (Table No. I) we obtain the following results:

The average duration of the first group was 7.5 days, the average maximum pressure 30.30 inches, and the average velocity of progression 20.4 miles per hour. The second group averaged 7.5 days, 30.23 inches, and 16.5 miles per hour. The third group averaged 6.5½ days, 30.26½ inches, and 6½ miles per hour.

The last group presents rather unsatisfactory data, owing to the peculiar situation and movement of the areas. From a study of the distribution of mean atmospheric pressure for the month, and of the movement of both highs and lows, it appears quite probable that the areas of the third group were simply outcroppings of a very extensive and persistent anti-cyclone lying off the Atlantic coast, with its centre slowly oscillating north and south in about the meridian of the Bermudas.

Certain important effects have resulted from this disposition of pressure, which are briefly referred to as follows:

First. The interruption of the progressive easterly movement of the areas in the 1st and 2d groups, which condition was shown by the irregular paths, in most instances the tracks curving upon themselves several times, with the evidence that the areas were slowly merging into a larger anti-cyclone off the coast. This incurving of the paths was confined, as might be expected, to the region of country along the Atlantic coast, and the progressive velocity east of the eighty-second meridian, as compared with that east of the ninety-seventh, showed an average diminution of 7.7 miles per hour.

Second. The interruption of the progressive easterly movement of the areas of low pressure, which may be expressed by saying that, on the average, the velocity east of the seventy-second meridian was reduced 3.3 miles per hour, as compared with the velocity east of the ninety-seventh meridian.

Third. The northeasterly trend of the low pressure areas east

of the seventy-seventh meridian, the average latitude of departure being 45°. Compared with the average values for the past sixteen years the number of high areas for July, 1889, shows an increase of 3.1, and also a greater number than any other year except 1885, when they reached the present number, nine. The maximum pressure shows an increase of .08 inch.

The accompanying tables (i and ii) have been prepared to present in graphic form some of the notable features and prevailing characteristics of the high pressure areas for July, 1889.

From a study of the development and movement of anti-cyclonic areas it is found that to their influence may be traced some of the highest wind velocities of the month and the largest rainfalls. These phenomena are located in the southeast quadrant of the high, where the cold westerly winds first come in contact with the warm, moist, southerly winds of the disappearing low, in the southeast quadrant of which the more violent local storms (tornadoes, hail-storms, and thunderstorms) developed.

Considering the records for the past seventeen years the average monthly number of high areas is 5.9, or 3.1 below the number for the current month, and the average maximum pressure is 30.19, or .08 inch below the current month.

The following is an interesting comparison of the average monthly values of the three groups of high areas:

Group number 1: Maximum rise in pressure in twelve hours, .30 inch; maximum fall in temperature in twelve hours, 21°; maximum wind velocity, in miles per hour, 49; lowest temperature, 37°; absolute fall in temperature in twenty-four hours, 26°; minimum dew-point, 7°; maximum fall in dew-point in twenty-four hours, 22°; maximum rainfall in twenty-four hours, 4.23 inches.

Group number 2: Maximum rise in pressure in twelve hours, .28 inch; maximum fall in temperature in twelve hours, 17°; maximum wind velocity, in miles per hour, 42; lowest temperature, 29°; absolute fall in temperature in twenty-four hours, 22°; minimum dew-point, 2°; maximum fall in dew-point in twenty-four hours, 20°; maximum rainfall in twenty-four hours, 4.23 inches.

Group number 3: Maximum rise in pressure in twelve hours, .21 inch; maximum fall in temperature in twelve hours, 12°; maximum wind velocity, in miles per hour, 31.5; lowest temperature, 52°; absolute fall in temperature in twenty-four hours, 12°; minimum dew-point, 51°; maximum fall in dew-point in twenty-four hours, 12; maximum rainfall in twenty-four hours, 3.81 inches.

A careful examination of the above comparisons reveals the fact that the areas in group number 1 were accompanied by the most decided changes in pressure, temperature, wind velocity, and moisture, and exhibited the greatest energy of any of the three groups. The average velocity of progression also much exceeded this value for the other two groups. The areas in group number 2 were accompanied by the lowest temperatures and dew-points, and by greater precipitation than attended the areas of group number 3. The latter, however, were marked by the maximum pressures of the month, due undoubtedly to the continued high pressure off the Atlantic coast.

Areas number v, vii, and viii were the most important anti-cyclones which traversed the country during the month. The two former came from the Northwest Territory and the latter from the north Pacific coast. Each area was attended with excessive precipitation, number viii being the most prominent in this respect, the effect of its decrease in temperature being experienced along the entire Gulf and Atlantic coasts.

The influence of number v on precipitation was most decided throughout the upper Mississippi valley, and of number vii in the Missouri valley.

Recapitulation.—The most prominent features of the month concerning high pressure areas are as follows:

1. A persistent high area off the Atlantic coast, which left a decided effect upon the mean reduced pressure for the month.
2. A marked interruption in the easterly movement of high areas east of the eighty-second meridian.

3. The influence of high areas on precipitation, giving rise to the heaviest rainfalls of the month.

4. The twelve-hour change in pressure was the maximum one for each area during the month, and occurred between 8 p. m. and 8 a. m. in all cases, except for area number v, when it took place between 8 a. m. and 8 p. m.

5. The twelve-hour change in temperature was the maximum one for each area during the month, and occurred between 8 a. m. and 8 p. m. in all cases, except for area number ii, when it took place between 8 p. m. and 8 a. m.

The following tables exhibit in a concise manner some of the more prominent characteristics of the high areas:

TABLE No. I.

No.	First observed.			Last observed.			Duration.	Velocity per h. r.	Highest pressure.		
	Date.	Lat. N.	Long. W.	Lat. N.	Long. W.				Date.	Station.	Reading.
I.....	1	43	67	43	59	4.0	11.0	1	Halifax, N.S.		30.44
II.....	1	44	125	35	82	9.0	23.8	2	Spokane Falls, Wash.		30.36
III.....	4	44	127	43	81	8.0	19.1	9	Port Angeles, Wash.		30.28
IV.....	8	50	72	49	67	2.0	12.5	10	Fort Custer, Mont.		30.14
V.....	10	52	115	35	72	8.0	15.5	16	Father Point, Quebec.		30.20
VI*						17.0†		13-4	Anticosti Island		30.20
VII.....	20	50	114	47	59	7.0	17.6	27	Chicago, Ill.		30.26
VIII.....	26	47	125	42	86	5.5	19.7	30	Titusville, Fla.		30.26
IX†						3.0†		31	Jupiter, Fla.		30.26
									Sydney, C. B. I.		30.26
									Dodge City, Kans.		30.26
									Wood's Holl, Mass.		30.25
Mean.....		47	93	42	72	7.0†	17.0				30.27

* Stationary over Florida and the east Gulf. † Centre of anti-cyclone too far off the Atlantic coast to afford reliable data.

TABLE No. II.

No.	Maximum rise in pressure for twelve hours.			Maximum abnormal fall in temperature for twelve hours.			Maximum wind velocity.		
	Amount.	Station.	Date.	Amount.	Station.	Date.	Miles per hour.	Direction.	Date.
1	.28	Sydney, N. S.	1	1.0	Halifax, N. S.	1	28	w.	2
2	.44	Denver, Colo.	2	2.5	Denver, Colo.	2	44	nw.	1
3	.26	Fort Sully, Dak.	7	2.5	Cheyenne, Wyo.	7	56	nw.	9
4	.13	Quebec, Quebec.	9	16	Eastport, Me.	8	26	ne.	10
5	.28	Harrisburg, Pa.	15	16	Valentine, Nebr.	13	46	n.	14
6	.18	Shreveport, La.	15	10	Jacksonville, Fla.	15	36	w.	11
7	.28	Bismarck, Dak.	21	19	Montgomery, Ala.	23	38	nw.	21
8	.30	do	29	15	Dodge City, Kans.	26	46	ne.	30
9	.24	Sydney, N. S.	29	10	Q'Appelle, N. W. T.	30	36	sw.	30
					New York City		40	s.	31
Mean	.26			16			40		

Remarks concerning Table No. II.

I.—This high was probably the western edge of a very extended area central south of Newfoundland.

II.—This area appeared off the Oregon coast on the 1st, reached the New Jersey coast by the 6th, thence curved to the southwest and remained nearly stationary in North Carolina from the 7th to 10th. This area is a continuation of high area number vi in June REVIEW.

III.—This area appeared off the North Pacific coast on the 4th and moved slowly eastward with diminishing energy, disappearing over the upper lakes on the 12th under the influence of low areas numbers ii and iv.

IV.—This high appears to have been the southern edge of an area central off the southeastern coast of Hudson Bay.

V.—This area appeared near British Columbia on the 10th, reached North Carolina on the 16th, where it remained nearly stationary on the coast to the 19th.

VI.—This area remained nearly stationary over the eastern Gulf and Florida from the 12th to the 29th. It was probably the western edge of a large area central over the Bahamas.

VII.—This area appeared north of Montana on the 20th and

moved thence slowly eastward over the Lake region, disappearing over Nova Scotia on the 27th.

VIII.—This area appeared off the North Pacific coast on the 26th and moved rapidly westward to the Mississippi Valley, where it was central on the 31st.

IX.—This area was probably the western edge of an anti-cyclone, the centre of which oscillated between the Bermudas and Nova Scotia.

AREAS OF LOW PRESSURE.

Fourteen such areas affected the weather of the United States during the month of July. They may be divided into three groups, according to conditions of formation and location of development. The first group includes those areas (i, iii, x, xiii, and xiv) which entered the United States from the Northwest Territory. The second group embraces those areas (ii, iv, vi, vii, xi, and xii) which developed from a permanent low over the middle plateau. The third group embraces those areas (v, viii, and ix) which developed as secondary depressions. The average values for the first group are as follows: duration, 5.4 (+0.7*) days; velocity of entire path, 18.7 (—3.4*) miles per hour; minimum pressure, 29.48 (—0.09*) inches; velocity east of the seventy-second meridian, 14.7 (—7.2*) miles, or a diminution of 3.8 miles as compared with the velocity east of the ninety-seventh meridian. For the second group: duration, 6 (+1.3*) days; velocity of entire path, 23.5 (+1.4*) miles per hour; minimum pressure, 29.59 (+0.02*) inches; velocity east of the seventy-second meridian, 26.7 miles per hour, or a diminution of 1.3 miles as compared with the velocity east of the ninety-seventh meridian. For the third group: duration, 2.2 (—2.5*) days; velocity of entire path, 25.1 (+3.0*) miles per hour; minimum pressure, 29.69 (+0.12*) inches. The entire path of area number v was east of the seventy-second meridian, and the paths of viii and ix did not extend beyond the ninety-seventh meridian. A further comparison of these groups exhibits the following results:

Group number 1 gives average values for the month as follows: maximum wind velocity in miles per hour, 42.8; maximum fall in pressure in twelve hours, .38 inch; maximum rise in temperature in twelve hours, 20°.2; highest temperature, 104°.4; absolute rise in temperature in twenty-four hours, 21°.2; maximum rainfall in twenty-four hours, 4.28 inches; maximum dew-point, 73°.6; maximum rise in dew-point in twenty-four hours, 19°.2.

Group number 2 gives the following average values for the month: maximum wind velocity in miles per hour, 46.3; maximum fall in pressure in twelve hours, .28 inch; maximum rise in temperature in twelve hours, 14°.5; highest temperature, 107°.3; absolute rise in temperature in twenty-four hours, 14°.3; maximum dew-point, 80°.3; maximum rise in dew-point in twenty-four hours, 22°.0; maximum rainfall in twenty-four hours, 3.79 inches.

Group number 3 gives the following average values: maximum wind velocity in miles per hour, 30.7; maximum fall in pressure in twelve hours, .19 inch; maximum rise in temperature in twelve hours, 10°.3; highest temperature, 95°.3; absolute rise in temperature in twenty-four hours, 11°; maximum dew-point, 75°.3; maximum rise in dew-point in twenty-four hours, 16°.6; maximum rainfall in twenty-four hours, 3.89 inches.

From the above comparison of monthly average values it is found that the low pressure areas in group number 1 displayed the greatest energy and were attended with the greatest precipitation and most decided changes in temperature and moisture.

Low area number xiii, of group number 1, which appeared in the Northwest Territory on the afternoon of the 23d, is credited with the heaviest rainfalls of the month, but they were really caused by the advance of high area number viii, which on the 30th and 31st was moving eastward in the central Mississippi and Ohio valleys. The heaviest rainfalls of the month occurred in the Gulf and Atlantic coast states under

the influence of advancing high areas, the cold air from which mingled with the warm, moist currents over the Gulf Stream, thereby giving rise to rapid and heavy condensation.

Low area number vii, of group number 2, and number viii, of group number 3, were attended with very heavy rainfalls and the most destructive floods of the month. Number vii developed over the middle plateau on the 13th and passed thence slowly northeastward to the Saskatchewan Valley, where on the 15th it changed its course to the eastward, and on the 17th to the southeastward, passing over Lakes Superior and Michigan, being central on the afternoon of the 18th over Lake Huron. At this juncture the depression was joined by low area number viii, which developed in southern Dakota on the 17th, as a secondary depression. While number vii was moving eastward over Manitoba, number viii moved into southern Nebraska, and thence northeastward to lower Michigan. On the 18th and 19th, while this combined depression was moving over the lower lakes, heavy precipitation and destructive floods occurred in southern and eastern Ohio, West Virginia, and western Pennsylvania. It was reported from West Virginia that the property of three entire counties in the western part of the state was almost completely destroyed, and more than thirty lives lost. This area disappeared south of Nova Scotia on the 21st.

The heavy rainfalls and floods in Iowa, Nebraska, central Kansas, northern Missouri, and northern Illinois, attended low area number vi which developed over the middle plateau on the 11th and passed thence eastward to the Mississippi Valley, where it was central on the morning of the 14th. Twenty-four hours later it was on the New Jersey coast, and thence moved directly out to sea.

The following are certain average monthly values of low pressure areas for a number of years: Number of storms (19 years), 9.8. Position first observed (17 years), lat. N. 45° 2'; long. W. 99° 2'. Position last observed (17 years), lat. N. 46° 0'; long. 71° 9'. Duration in days, 2.5. Position of middle of path (19 years), lat. N. 45° 7'; long. W. (17 years), 85° 6'. Length of path in degrees of longitude at its average parallel (17 years), 27° 4'. Hourly velocity, in miles, of storm-centre along its average parallel (17 years), 23.3 miles. Hourly velocity, in miles, of storm-centre along its actual path (8 years), 24.3 miles. Minimum pressure (17 years) 29.63 inches.

Compared with the average values for many years the total number of depressions for July, 1889, shows an excess of 4.2. The place of beginning and ending shows a lower latitude, the former by 3° 2' and the latter by 1°. The average latitude of the entire paths shows a tendency southward by 2° 2'. The duration of the depressions shows an increase of 2.2 days. The length of the tracks of the depressions show an increase of 7° 6'. The velocity of progressive movement shows a decrease of 7.8 miles per hour, and the minimum pressure a decrease of .06 inch.

Recapitulation.—The prominent and significant features of low pressure areas for the month may be summarized as follows:

1. Permanent low pressure over the middle plateau.
2. A large increase in the number of depressions, being exceeded but once (15 areas in 1871) in 19 years, and equaled but once, 1872, in 18 years.
3. A marked diminution in the progressive movement east of the seventy-second meridian, owing to the presence of a persistent high pressure area off the Atlantic coast.
4. Excessive twenty-four hour rainfalls and general excess in precipitation in the Missouri Valley, east Gulf, and Atlantic coast states.
5. A marked excess in the duration of the depressions, in the length of their paths, but a decrease in pressure and in the velocity of progressive movement; which facts, taken in connection with the large increase in the number of depressions, point significantly to the excessive precipitation of the month.
6. The twelve-hour change in pressure was the maximum one for each depression during the month, and occurred between

8 a. m. and 8 p. m. in all cases, except for area number viii, when it took place between 8 p. m. and 8 a. m.

7. The twelve-hour change in temperature was the maximum one for each area during the month, and occurred between 8 a. m. and 8 p. m. in all cases, except for areas number i and xi, when it took place between 8 p. m. and 8 a. m.

The following tables exhibit the principal facts regarding these low areas:

TABLE NO. I.

No.	First observed.			Last observed.			Duration.	Velocity per h'r.	Lowest pressure.	
	Date.	Lat. N.	Long. W.	Lat. N.	Long. W.				Station.	Reading.
I.....	1	0	0	0	0	Days.	Miles.			Inches.
II.....	2	45	102	48	56	5.5	18.0	3	Rockliffe, Ont.....	29.60
III.....	3	33	119	48	84	6.5	22.5	5	Salt Lake City, Utah...	29.48
IV.....	6	52	116	43	102	3.0	18.8	4	Qu'Appelle, N. W. T....	29.42
V.....	7	45	67	45	60	0.5	29.2	8	Anticosti, Gulf of St. L.	29.54
VI.....	11	38	114	40	73	3.5	30.2	15	Bird Rocks, Gulf of St. L.	29.78
VII.....	13	38	113	46	57	8.5	20.1	16	Sydney, C. B. I.....	29.64
VIII....	17	43	100	44	83	1.5	27.0	17	Atlantic City, N. J.....	29.46
IX.....	18	39	101	34	74	4.5	19.1	18	Qu'Appelle, N. W. T....	29.66
X.....	18	52	111	49	60	6.0	16.4	25	Rapid City, Dak.....	29.64
XI.....	21	36	115	42	64	7.0	26.7	23	Fort Elliott, Tex.....	29.44
XII.....	22	31	108	35	94	3.0	17.8	23	Anticosti, Gulf of St. L.	29.68
XIII....	23	52	113	50	68	7.0	12.3	28	Salt Lake City, Utah...	29.76
XIV....	29	51	117	52	98	2.0	28.1	30	El Paso, Tex.....	29.40
									Fort Sill, Ind. T.....	29.52
									Prince Arthur's L'g, Ont	
									Medicine Hat, N. W. T.	
Means....		42.3	112	44.6	73.3	4.7	22.1			29.57

TABLE NO. II.

Number.	Maximum fall in pressure for 12 hours.			Maximum abnormal rise in temperature for 12 hours.			Maximum wind velocity.		
	Amount.	Station.	Date.	Amount.	Station.	Date.	Miles per hour.	Direction.	Date.
1	.30	Rockliffe, Ont.....	3	13	Father Point, Quebec	4	48	s.	1
2	.24	Winnemucca, Nev....	5	17	Yuma, Ariz.....	3	30	se.	3
3	.58	Calgary, N. W. T.....	3	29	Denver, Colo.....	4	48	e.	7
4	.32do.....	9	19	Fort Buford, Dak....	10	36	se.	11
5	.16	Eastport, Me.....	7	8	Eastport, Me.....	7	28	sw.	7
6	.34	Calgary, N. W. T.....	12	12	Medicine Hat, N. W. T.	12	52	ne.	15
7	.20	Swift Current, N. W. T.	16	17	Qu'Appelle, N. W. T.	14	40	sw.	16
8	.25	Saint Vincent, Minn..	21	11	Atlantic City, N. J....	20	34	s.	17
9	.16	Minneapolis, Minn....	21	11	Atlantic City, N. J....	20	34	s.	20
10	.26	Halifax, N. S.....	21	11	Atlantic City, N. J....	20	34	s.	20
11	.18	Rio Grande City, Tex.	18	12	Fort Elliott, Tex.....	18	30	nw.	18
12	.26	Swift Current, N. W. T.	19	20	Olympia, Wash.....	19	40	w.	19
		Salt Lake City, Utah..	23	12	Pueblo, Colo.....	25	60	n.	25
		Portland, Me.....	27	10	Lynchburgh, Va.....	27	60	sw.	25
					Denver, Colo.....	26	60	nw.	26
13	.32	Calgary, N. W. T.....	22	17	Fort Custer, Mont....	26	36	sw.	27
					Helena, Mont.....	25	36	sw.	28
14	.42do.....	29	22	Medicine Hat, N. W. T.	29	42	se.	31
								s.	31

Remarks concerning Table No. II.

I.—This depression is a continuation of low area number x in June REVIEW, central in northern Montana on the 30th ultimo.

II.—This area remained about stationary over California and the middle plateau from the 2d to the 6th, on which latter date it moved rapidly eastward to Nebraska. During the 7th and 8th the depression remained nearly stationary over the middle slope, but during the 9th moved eastward to Wisconsin. On the 11th it reached eastern New York, and the following day disappeared south of Nova Scotia.

III.—This area joined number ii in Nebraska on the 6th, but separated from it on the 7th and thereafter formed a distinct depression.

IV.—This area appeared over the middle plateau on the 6th and 7th and moved thence eastward to the upper lakes, over which region the depression was central on the 13th. By the morning of the 15th the area was central near Newfoundland, passing thence out to sea.

V.—This area probably appeared as the secondary effect of a large depression central south of Newfoundland.

VI.—This area reached the New Jersey coast on the 15th, passing thence eastward out to sea.

VII.—Developed over the middle plateau on the 13th and 14th, and moved thence northeastward over Montana to the Saskatchewan Valley where on the 16th it changed its course to the eastward and on the 17th to the southeastward, passing over the upper lakes, where on the 18th it joined with number viii over Lake Huron.

VIII.—This area developed in southern Dakota on the 17th as a secondary depression to number vii, then central in Manitoba. During the day it moved southward into Nebraska and thence eastward to the upper lakes, where on the 18th it joined with number vii over Lake Huron.

IX.—This area developed in west Kansas on the 18th, was central in northern Texas on the 19th, and moved thence eastward with diminishing energy to the Carolina coast, where it disappeared on the 22d.

X.—Developed in the Saskatchewan Valley on the 19th and moved rapidly eastward along the northern border of the country, passing the upper lakes on the 21st and reaching the Gulf of Saint Lawrence on the 23d.

XI.—This area developed over the middle plateau on the 21st and 22d and moved slowly eastward to the Missouri Valley, where on the 25th it joined with number xii in eastern Kansas.

XII. This area combined with number xi in Kansas on the 25th, and thereafter moved eastward as one depression, reaching the New Jersey coast on the 27th. On the 28th the depression disappeared south of Nova Scotia.

XIII.—Developing on the 24th north of Montana, this area moved slowly eastward, just north of the United States, reaching the lower Saint Lawrence valley on the 30th.

XIV.—This area sub-divided on the 31st, forming two centres of diminished energy, one being in Manitoba and the other in southern Dakota. It seems probable that these two centres joined in Minnesota in one depression on the following day.

NORTH ATLANTIC STORMS FOR JULY, 1889 (pressure in inches and millimetres; wind-force by Beaufort scale).

The paths of the depressions that appeared over the north Atlantic Ocean during July, 1889, are shown on chart i. These paths have been determined from international simultaneous observations by captains of ocean steamships and sailing vessels received through the co-operation of the Hydrographic Office, Navy Department, and the "New York Herald Weather Service."

Seven depressions have been traced for July, 1889; the average number traced for the corresponding month of the last six years being seven and one-half. Of the depressions traced for the current month, three, numbers 3, 4, and 5, were continuations of areas of low pressure which first appeared over the North American continent; three are first charted over mid-ocean in high latitudes, and one apparently originated northeast of the Banks of Newfoundland. The movements of the depressions over the western part of the ocean were irregular, which fact may be attributed to the abnormally high pressure which prevailed during a considerable portion of the month to the east and southeast of the Banks of Newfoundland. No depressions with well-defined movements of translation appeared within the region of observation over the more southern portions of the ocean, the Gulf of Mexico, or the Caribbean Sea. Under date of July 23d, the Rev. Benito Vines, of the Belen College Observatory, Havana, Cuba, reports as follows: "Since Sunday, 21st, there have been observed indications of a cyclone in the first quadrant. This hurricane is moving in the beginning of its trajectory in the longitude of the Bahamas, in a direction toward the New Channel, in the vicinity of which it will probably recurve." The following dispatch was sent to the New York Herald from the City of Mexico, via Galveston: "July 12th, a terrific storm is raging at Vera Cruz, and the shipping there is in great peril. The Spanish bark 'Hijas de Vinas' is dragging her anchor. The officers of the Mexican man-of-war 'Libertad,' which is lying in the roadstead exposed to the whole fury of the gale, are doing all in their power to save their ship. Her anchorage is very insecure." Over the western portion of the ocean, north of the thirty-fifth parallel, fresh gales prevailed from the 5th to 17th, and 20th to 26th, attaining the force of strong gales on the 10th, 11th, and 15th to 17th, when the barometric pressure fell to about 29.50 (749). Over mid-ocean the stormy periods were embraced between the 1st to 9th, 17th to 20th, 23d, 24th, and 29th to 31st, strong gales being reported from the 5th to 8th, 17th and 18th, and the lowest barometric pressure, about 29.40 (747), on the 4th. Over the eastern part of the ocean, in the vicinity of the British Isles, unsettled weather prevailed from the 7th to 11th, 16th, 19th

to 26th, 30th and 31st, strong gales being reported on the 21st, 24th, and 25th, and barometric pressure falling to about 29.40 (747) being noted on the 24th.

Compared with the corresponding month of previous years the storms which appeared over the north Atlantic Ocean during July, 1889, corresponded closely in number with the average; they were deficient in energy, and pursued irregular paths, more especially over the western part of the ocean. A noteworthy feature of the month was the absence of storms of tropical or subtropical origin advancing northward over or east of the United States. The storms traced over the north Atlantic for July in preceding years varied in number from five in 1884 to twelve in 1886. The storms of the middle latitudes of the north Atlantic Ocean seldom acquire great strength in July, the most destructive storms of the month generally appearing in the tropical or subtropical regions. Among notable West-Indian storms for July described in the REVIEW during the last six years were those of 1886 and 1887. The hurricane of 1887 advanced from Barbadoes Island westward over the Caribbean Sea and thence northward over the Gulf of Mexico to the east Gulf states from the 20th to the close of the month. This storm was very severe at Barbadoes Island on the 20th, and several vessels were wrecked. Several vessels were wrecked on the west coast of Florida and the north Cuban coast, and very heavy rainfall in the Gulf States, in connection with high winds and swollen rivers, caused great destruction to the growing crops and the public highways. In 1886 two storms advanced northward from the vicinity of Cuba, neither of which were very destructive in their character.

The following are brief descriptions of the depressions traced for July, 1889:

1.—This depression was central over mid-ocean in about latitude N. 54° on the 1st, with central pressure falling to about 29.70 (754), and moderate to fresh gales, whence it moved northeasterly and disappeared north of the region of observation after the 2d.

2.—This depression appeared northeast of the Banks of Newfoundland on the 3d, with pressure about 29.60 (752), and thence passed southeast to about N. 47°, W. 38° by the 4th, in which position pressure falling to about 29.40 (747) was reported. By the 5th the centre of depression had advanced southeast to the forty-second parallel, whence it recurved northward to the forty-eighth parallel by the 6th, this movement being apparently due to the combined influence of an area of high pressure to the eastward and southward and the advance from the westward, south of Newfoundland, of an area of low pressure. By the 7th the storm-centre had moved westward to about the thirty-eighth meridian, after which it apparently united with